MERCURY SWITCH
DATA COLLECTION PILOT PROJECT

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FINAL REPORT

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Disclaimer: The views and ideas expressed in this report are those of the author and do not necessarily reflect the views and policies of the New Jersey Department of Environmental Protection.

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EXECUTIVE SUMMARY

The mercury switch data collection pilot project was developed as part of the State of New Jersey's efforts to reduce the amount of mercury in the environment. The goals were to determine the effectiveness of an End-of-Life Vehicle switch removal program and estimate the costs in order to develop and implement a cost effective and reliable program.

Five (5) vehicle dismantling and scrap processing/auto wrecking facilities participated in the pilot project which resulted in 358 vehicles being prepared for shredding to produce 'low mercury content shredded scrap'. As part of an associated effort, the resulting scrap was melted at a steel mill for voluntary stack testing to observe the impact on mercury emissions.

It was learned that on average, a vehicle contained 0.8 mercury convenience lighting switches. Each mercury switch contained an average of 1.2 grams of mercury.

Although it takes less than 1 minute to remove the switch from the vehicle, it takes 2 to 3 minutes to examine a vehicle hood and trunk to determine the presence or absence of convenience lighting switches. This examination could be performed in conjunction with other inspections performed by auto dismantlers and auto wreckers. It takes approximately 1 minute to document the vehicle and switch removal data. Total time required per mercury switch removed is less than 5 minutes. Time is dependent upon the condition of the vehicle at the time of inspection.

Removal of all convenience lighting switches with the exception of obvious mechanical units is required, since lists of vehicles purported to contain or not contain mercury switches are unreliable. Only Toyotas and Hondas can be eliminated from the inspection process. The mercury containing bullets or capsules should be removed from the switches prior to shipping them off-site for processing under the Universal Waste Rules. Removal of the capsules to the greatest extent possible will minimize the cost of handling and processing of the mercury switches.

The total cost of mercury switch removal, handling, transportation and proper disposal is estimated to be $3.00 per switch. On this basis, a switch removal program in New Jersey would have an estimated cost of $1.5 million annually, based on approximately 500,000 vehicles shredded in the state annually. Mercury convenience lighting switches will be present in end-of-life vehicles for at least the next 15 years.

Preliminary data, from the associated effort involving testing of air emissions from a steel mill, suggest that removal of mercury switches from vehicles prior to shredding results in a reduction in mercury emissions of approximately 50 percent.

It is desirable that a switch removal program be implemented on a regional basis due to the significant amount of interstate commerce involved in the handling and processing of end-of-life vehicles, as well as the marketing of shredded scrap.

MERCURY SWITCH DATA COLLECTION PILOT PROJECT

1.0 Background

The project was developed as part of the State of New Jersey's efforts to reduce the amount of mercury in the environment. The goals of the project include determining the effectiveness of a switch removal program and estimating the cost of such a program. Such a program would collect mercury-containing switches from end of life vehicles (EOLV's) in order to maximize the amount of mercury removed from scrap vehicles prior to processing into marketable raw material for use by steel mills and foundries.

It has been estimated that 8.8 to 10.2 metric tons of mercury are contained in scrap autos recycled in the US annually[1]. The primary source of mercury is in convenience lighting switches located in the trunks and hoods of many vehicles. Due to the fact that most mercury switches contain mercury in small steel canisters or 'bullets' within them (Figure 1), it is believed that during the shredding and magnetic separation process, most of the mercury 'bullets' are collected as part of the shredded steel scrap. When the scrap steel is melted at the steel mill or foundry, the mercury is vaporized and portions not collected by existing air pollution control devices are emitted as airborne contaminant. A small number (estimated at less than 2 percent) of mercury convenience lighting switches contain mercury in a small glass vial (Figure 2) which is likely broken in the shredding process, releasing the mercury to the waste stream produced by the shredding facility.

Steel mills and foundries which utilize shredded steel scrap as a portion of the raw material charge are believed to be among the largest point sources of mercury emissions in New Jersey. The NJ Mercury Task Force in 2002 estimated that approximately 1000 pounds of mercury are emitted annually from the melting of shredded scrap in New Jersey.

A few programs currently exist in the U.S. to encourage removal and proper handling of automobile mercury switches. Maine, Michigan, Minnesota, New York, Vermont and Connecticut have programs which have initiated outreach efforts, developed educational materials and have participation from associations representing appliance and automobile recyclers. However, lack of economic incentives have resulted

in limited effectiveness in collecting mercury. Automotive recyclers operate on low margins and will not voluntarily undertake the collection and disposal of mercury switches.

The purpose of the Mercury Switch Data Collection Pilot Project is to obtain data and information necessary to develop and implement a cost-effective and reliable program to remove mercury switches from end-of-life vehicles that maximizes the amount of mercury removed.

2.0 Overview of Automobile Recycling and Mercury Switch Removal Programs

Automobile recycling in New Jersey is accomplished primarily through the activities of several hundred auto dismantlers and recyclers in conjunction with the seven (7) scrap metal shredding facilities located throughout the state. Some vehicles are processed and handled by scrap processing facilities which only prepare the end-of-life vehicles for shredding, no parts are removed for resale.

The bulk of the vehicle dismantling and recycling facilities are small businesses with 10 or fewer employees. Several hundred of these facilities operate in New Jersey, many are members of the Automotive Recyclers Association of New Jersey (ARA). Such facilities with a Standard Industrial Classification (SIC) Code of 5015 (North American Industry Classification System Code (NAICS) 421140) are primarily engaged in the dismantling of motor vehicles for the purpose of selling parts. Once all the parts with significant resale value are removed from an end-of-life vehicle, the remaining hulk is prepared for the scrap metal shredder. Such processing includes removal of the battery, fluids and CFC's. The hulk is usually crushed or flattened for volume reduction for shipment to the shredder.

Some scrap processors/auto wreckers only prepare end-of-life vehicles for shredding, removing the battery and draining fluids, followed by volume reduction for shipment to a shredding facility. Several dozen of these facilities operate in New Jersey, many are members of the Institute of Scrap Recycling Industries (ISRI). Such facilities have a Standard Industrial Classification Code of 5093, North American Industry Classification System Code of 421930. This group is defined as establishments engaged in wholesaling scrap from automotive, industrial and other recyclable materials and includes auto wreckers primarily engaged in dismantling motor vehicles for the purpose of wholesaling scrap.

Vehicle dismantling and recycling facilities may process from several dozen to several hundred end-of-life vehicle hulks for delivery to the shredder per month. Scrap processing/auto wrecker facilities may process from a dozen to several hundred end-of-life vehicles daily.

The seven shredding facilities located throughout New Jersey (Table 1) have processing capacities ranging from 25 to more than 100 cars per hour. Most of the

shredding facilities accept scrap vehicles from out-of-state as well. Automobiles are accepted from New York, Connecticut, Pennsylvania, Delaware and Maryland.

TABLE 1

SCRAP METAL SHREDDING FACILITIES IN NEW JERSEY

Camden Iron & Metal Co.
Camden, Camden County

Cumberland Recycling of South Jersey
Millville, Cumberland County

Hugo Neu Schnitzer East
Jersey City, Hudson County

Mercer Recycling
Ewing Township, Mercer County

Metal Management Northeast, Inc.
Newark, Essex County

Parkway Iron & Metal Co.
Clifton, Passaic County

Trenton Iron & Metal Corp.
Trenton, Mercer County

The shredder produces a high quality steel scrap product which is sold in a worldwide market for use by steel mills and foundries. The shredded steel product amounts to 65 to 70 percent by weight of the scrap material input to the shredder. A byproduct of the shredding process is a mixed non-ferrous metals concentrate, known as Zorba, which is sold for separation, recovery and recycling of the aluminum, copper, zinc and stainless steel content. This product amounts to 5 to 10 percent of the scrap input to the shredder. Finally, the Auto Shredder Residue (ASR) or 'fluff' as it is often called is considered a residual or ID 27 waste which is disposed in sanitary landfills. Such waste material amounts to approximately 25 percent by weight of the processed end-of-life vehicle hulk. Efforts are underway to decrease the amount of ASR requiring disposal

through the recovery and recycling of various plastics and other components. At present, ASR is often utilized as alternative daily cover at landfills accepting it for disposal.

On the basis of industry data reported to NJ DEP, approximately 500,000 vehicles are shredded annually in New Jersey. This results in production of approximately 400,000 gross tons of shredded steel product and approximately 165,000 tons of ASR from the processing of vehicles. Shredders also process 'light iron' which consists of household white goods, appliances, and other light gauge steel scrap e.g. steel shelving, file cabinets, etc. The typical shredding facility processes 55 to 60 percent vehicles and 40 to 45 percent light iron.

As discussed previously, it is believed that the bulk of the mercury switches are collected with the shredded steel product due to the fact that in most switches, the mercury is contained in small steel 'bullets' which are readily attracted by a magnet. Recovery and cleaning of the shredded steel scrap is accomplished primarily by magnetic separation. Some portion of the mercury switches would remain within the ASR due to the non-magnetically attracted plastic housings, which may not be destroyed in the shredding process. Also, certain mercury switches, primarily those found in Volvo vehicles contain mercury in a glass tube which is likely destroyed in the shredding process, releasing the metallic mercury to the 'fluff'.

In order to efficiently remove mercury switches prior to the shredding process, removal must occur at the auto dismantler/recycler or the scrap processing yard prior to crushing or flattening for shipment to the shredder.

Studies[2] have indicated that 99 percent of the mercury in vehicles is contained in switches. Of the vehicles containing mercury, the convenience light switches account for 87 percent of the total mercury, while antilock brake system (ABS) switches account for 12 percent[3]. Therefore, removal of the mercury convenience lighting switches has the potential to substantially reduce mercury emissions at steel mills and foundries. If certain readily accessible ABS switches are included in the program, such as those contained in Chrysler and Ford products, potential emissions reductions are greater. Figure 3 shows a typical Chrysler product ABS switch containing 3 'bullets'.

Several states have implemented mercury switch removal programs. Maine implemented a mandatory program effective January 1, 2003, requiring automakers to

establish and maintain consolidation facilities throughout the state to which mercury switches removed may be transported by persons performing removal. The auto manufacturers pay at least $1.00 per switch as partial compensation for removal, storage and transportation of the switches. The Maine Department of Environmental Protection has prepared an "Auto Dismantlers Guide to Recycling Mercury Switches and Mercury Lamps" last revised in August 2003, which provides excellent guidance for the location and removal of convenience lighting switches.

The State of Minnesota requires vehicle salvage facility operators to make a good faith effort to remove mercury switches from motor vehicles before they are crushed.

Wisconsin encourages removal of mercury switches and has prepared education and information assistance documents.

Michigan has conducted a study on mercury switch removal and is developing a removal program.

Connecticut has prepared and issued an "Auto Recycling Industry Compliance Guide, " dated January 2004 which provides guidance regarding the proper removal and handling of vehicle convenience lighting switches.

The US Environmental Protection Agency has drafted National Emission Standards for Hazardous Air Pollutants from Iron and Steel Foundries (40 CFR Part 63, Subpart EEEEE) which address mercury emissions as one of the hazardous air pollutants(HAP's). As approved, but not yet adopted, the standard would mandate Work Practice Standards for all iron and steel foundries in the U.S. that meet the Clean Air Act definition of Major Source of Hazardous Air Pollutants. The Work Practices include the purchase of only 'Certified Scrap'-from which all known mercury switches were removed, or the non-use of automotive scrap. As a result, scrap suppliers would be required to remove accessible mercury convenience lighting switches from the trunks and hoods of any automobile bodies contained in the scrap and certify removal in order to supply scrap to facilities affected by the rule. Scrap purchasers would be responsible for inspecting the scrap supply to assure compliance with the requirements. It is unclear as to the timing of regulation adoption; publication in the Federal Register, and therefore promulgation is pending.

It should be noted that the NJ DEP has requested the US EPA to expand the rule to include all facilities which melt vehicle scrap in addition to those considered to be "major sources" as defined by the Clean Air Act.

On December 10, 2003, NJ DEP Division of Air Quality released proposed rules for Control and Prohibition of Mercury Emissions for Iron and Steel Melters in New Jersey. Such proposed rules were published in the New Jersey Register on January 5, 2004 for public review and comment. The public comment period ended March 5, 2004. Final rules are expected to be adopted mid-2004.

The proposed New Jersey Rule would require a 75 percent reduction of mercury emissions by iron and steel melters within 5 years or achievement of an emission rate limit for mercury per ton of steel/iron produced. The proposal would require Work Practice Standards very similar to those envisaged by the approved but not adopted Federal Regulations. Mills in New Jersey would be required to implement source reduction of mercury which could include purchasing and melting only scrap that has had mercury switches removed. Inspection and Quality Control/Quality Assurance would be required. A mercury minimization plan would be prepared by each scrap melting facility for review and approval by NJ DEP within 1 year of the effective date of the new rules. Such plan would describe the inspection and quality control/quality assurance program to assure mercury switch removal from the scrap.

The proposed rules will impact iron and steel melters as well as the nearly 300 auto dismantlers, scrap processing and auto wrecking facilities in New Jersey and numerous out-of-state facilities which supply scrap vehicles or shredded scrap to facilities in New Jersey.

3.0 Description of New Jersey Pilot Project

During early 2003, four (4) automobile dismantling and recycling yards, all members of ARA-NJ were selected to participate in the project. The facilities, all having NAICS Code 421140, were as follows:

First Class Auto Salvage
Hamilton Township, Mercer County

Lafayette Salvage, Inc.
Lafayette Township, Sussex County

North Jersey Auto Wreckers
Byram Township, Sussex County

Price Auto Wreckers, Inc.
Bridgewater Township, Somerset County

In addition, a scrap processor/auto wrecking facility, NAICS Code 421930 was selected for participation:

Noble Street Metals
Division of Hugo Neu Schnitzer East
Newark, Essex County

The five (5) facilities participated in the removal/recovery of trunk and hood convenience light switches from end-of-life vehicles on a pilot basis. In addition, removal/recovery of ABS switches from several 4-wheel drive Sport Utility Vehicles was accomplished. Data was acquired regarding mercury switch location and removal.

As a result of the pilot project, 358 vehicles (a total of 422.95 Gross Tons)[4] were prepared for shredding so that nearly 300 Gross Tons of 'low mercury content shredded scrap' could be prepared for melting and stack emission testing at a New Jersey steel mill. Preparation of the vehicles took place during May, June and July 2003. It should be noted that 100 percent of the scrap material sent to the shredder was vehicle scrap, no white goods were included.

Shredding of the 'mercury switch-free' vehicles was conducted at the Claremont Terminal Facility of Hugo Neu Schnitzer East (HNSE), Jersey City, Hudson County on July 30, 2003. As a result, 268.64 Gross Tons of shredded steel was shipped to the steel mill on October 4 and 6, 2003 for melting as part of the associated effort.

The associated melting and stack emissions testing effort was conducted at the Gerdau-Ameristeel, Sayreville Steel Mill, Sayreville, Middlesex County, New Jersey on November 5 and 6, 2003.

An instruction/guidance document, together with a data collection form was prepared and provided to all participating facilities (Appendix A). In addition, each facility was provided with information regarding the Universal Waste Rules as they relate to mercury switches (Appendix B) together with a properly labeled Universal Waste Container for use in storing recovered mercury switches.

A Quality Control/Quality Assurance Program was implemented to assure removal of the mercury switches from the pilot project vehicles. Such program involved the review of the data collection form, counting the switches collected and comparing that number to the total indicated on the data forms. Finally, on the order of 10 to 20 percent (varying by processing facility) of the prepared vehicles were inspected prior to crushing or shredding to be certain that convenience lighting switches had actually been removed.

Once the scrap automobiles had been shredded, the shredded steel product was stored in a separate location away from other shredded scrap on paved surface and contained away from other activities. The shredded scrap was shipped to Gerdau Ameristeel in Sayreville by truck and stored in a separate, secure area while awaiting use during the stack testing event.

Figures 5 through 18 document the pilot program chronology.

Stack testing at Gerdau-Ameristeel, Sayreville involved three (3) replicate runs in accordance with NJ DEP approved test protocol utilizing 'normal' scrap charges which included shredded scrap procured through routine scrap purchasing procedures. Three (3) replicate runs followed, utilizing the 'low mercury content shredded scrap'. In both cases, the shredded scrap was approximately 33 percent by weight of the total scrap metal charged to the furnace.

Results of the stack testing conducted October 22 and 23, 2003 (Normal Scrap Stack Test) and November 5 and 6, 2003 (using Low Mercury Content Shredded Scrap) indicated a 50 percent mercury emissions reduction on both a "pounds per hour" and

"pounds per ton of billet steel produced" basis. The results of the associated stack test effort are summarized in Table 2.

TABLE 2
STACK TEST DATA SUMMARY[5,6]

Scrap Charge(% by Weight)	10/22 & 10/13/03	11/5 & 11/6/03
Heavy Melt Scrap(HMS)	39.0	43.0
Plate & Structural(P&S)	13.3	12.7
Shredded Scrap	32.2	33.7
Municipal Scrap	5.0	0
Other(Turnings, Cast Iron, In-Plant Scrap)	10.3	10.7

Mercury Emissions(Average)	10/22 & 10/13/03	11/5 & 11/6/03
pounds/hour	0.106	0.0523
pounds/ton of billet steel	0.00095	0.00051

NOTE: Results presented are averages of the three (3) replicate runs conducted.

The results of emission testing are positive and indicative that removal of mercury switches has an impact on steel mill stack emissions. On a parallel track, the ASR produced during the shredding of the pilot project vehicles was sampled and tested for total mercury content. Three (3) random grab samples of ASR were taken on July 30, 2003 at the conclusion of the shredding run and shipped to the Washington Group Environmental Laboratory (NJ DEP ID #PA343). The samples were composited into one (1) sample at the laboratory. Total mercury content was determined to be 1.01 mg/kg. The laboratory report is included in Appendix D.

During October 2003, Hugo Neu Schnitzer East had obtained and submitted ten (10) grab samples of ASR produced during normal operations to a laboratory for total mercury analysis. The average mercury content was found to be 3.62 mg/kg with a range of 0.96 to 8.06 mg/kg.[7]

Mercury content of the ASR may be a surrogate for mercury content in the steel scrap, or at least an indicator of steel scrap mercury content.

4.0 Data Collection Summary

The five (5) facilities participating in the project were instructed as follows:

1. Remove all trunk and hood lighting switches and place them in the Universal Waste Container provided. DO NOT TAKE THE SWITCH ASSEMBLIES APART!

2. Record data for each vehicle on the Data Forms provided.

3. Mark the cars from which switches have been removed with a spray paint marking.

4. Store the Universal Waste Container until picked up by NJ DEP personnel.

To initiate the pilot project field work during March 2003, members of the project management team visited one of the participating facilities to randomly inspect cars to locate hood and trunk convenience lighting switches and remove them. The cars inspected were selected on the basis of ease of access and makes/models suspected of containing convenience light switches. A total of 13 vehicles were inspected and a total of 12 switch assemblies were located and removed. Table 3 documents the initial vehicles inspected.

It was learned that the primary tools required were a screw driver or pry bar, small socket wrench and a pair of wire cutters. Switches required less than 5 minutes each to locate and remove.

The other four (4) participating facilities were each visited, instructions and data forms provided to management personnel.

It was observed that after experiencing a learning curve for locating and removing convenience lighting switch assemblies, actual removal time averaged less than 1 minute per switch. However, the time required to inspect the hood and trunk of each vehicle to determine the presence or absence of switches was approximately 2-3 minutes per vehicle. Times varied, since it was not always easy to open the hood or trunk lids. In some cases trunks were shut and locked and the vehicles did not always have keys present. When this occurred, a forklift or other piece of heavy equipment was required to

pry open the trunk lid to permit inspection. Data recording required approximately 1 minute per vehicle.

TABLE 3
VEHICLES INSPECTED – 3/26/2003

1998	Lincoln Continental	No Switches
2000	Ford Taurus	No Switches
1992	Mercury Grand Marquis	Hood & Trunk Switches
1992	Mercury Sable	Hood & Trunk Switches
1994	Saturn	No Switches
1995	Monte Carlo	No Switches
1989	Corsica	Hood & Trunk Switches
1996	Chrysler Stratus	Trunk Switch
1993	Chrysler Dynasty	Trunk Switch
1987	Volvo 740 Turbo	Hood & Trunk Switches
2000	Olds Bravada	Hood Switch
2001	Chevrolet Blazer	Hood Switch
1994	Ford Explorer	No Switches

Copies of the Field Data Sheets and field data as completed by the facilities are included in Appendix C.

As a result of the pilot program, 358 vehicles were examined and switch assemblies removed. Average number of switches located and removed were 0.8 per car.

The Quality Control/Quality Assurance program involved members of the project management team visiting the participating facilities, to randomly inspect vehicles to verify mercury switch removal prior to crushing of the vehicles. Further, vehicles not crushed prior to shipment to the Hugo Neu Schnitzer East Claremont Facility for shredding were inspected at the Claremont Facility prior to shredding on July 30, 2003. A total of 14 vehicles were inspected immediately prior to shredding. Nine (9) of the vehicles had no switches, the other 5 vehicles had switches, yielding a total of 9 convenience lighting units. The 14 vehicles inspected, represented a total of 101 vehicles which had not been inspected prior to shipment to the Claremont Facility. These facilities had reported removal of 76 switch assemblies from the vehicles prior to shipment.

As a byproduct of the Quality Control/Quality Assurance process, it was learned that some automobiles, primarily luxury models, may contain small mercury switches for vanity mirror lighting in the passenger-side sun visor (See Figure 1). Further, it was learned that the 4-wheel drive ABS sensor switch located in the Chrysler Jeep Grand Cherokee was relatively easy to locate and remove under the rear seat. Such units contain three (3) steel cased mercury 'bullets' (See Figure 3).

5.0 Obstacles Encountered

The biggest obstacle to be overcome in the removal of mercury switches is the learning curve for locating and removing the switches. Although reference documents which included lists of vehicles purported to contain mercury convenience lighting switches were provided to all participating facilities, it was learned in the field that such documents were unreliable. Further, the reference documents had an initial negative impact of reinforcing participating facilities belief that older vehicles did not contain mercury switches. It was learned that trying to compare a vehicle year, make and model to the lists required too much time and often provided inaccurate data.

Field experience taught that the best procedure was to inspect the hood and trunk lids of all vehicles to locate and remove all convenience lighting switches in their entirety, with the exception of obvious mechanically activated switches. This proved to be the quickest, most reliable way to make sure all mercury switches were removed. In this way, it was possible to ultimately eliminate certain foreign makes of vehicles, such as Toyotas and Hondas which do not contain the switches, whereas most full-size domestic cars manufactured up to the early 1990's, appear likely to have at least one mercury convenience light switch.

The glass vial mercury switches require special handling to avoid breakage and release of the metallic mercury. Such units must be placed in plastic bags or plastic containers.

Some vehicles inspected were damaged to the point that opening hoods and/or trunk lids was difficult, requiring heavy equipment to open them. In some instances, trunk lids were locked with no key available, also requiring heavy equipment to assist in opening the lid.

Recordkeeping difficulties were encountered. The forms utilized required the make, model and year information be recorded for each vehicle. The Vehicle Identification Number (VIN) was not recorded. In many instances, it was difficult to determine the vehicle year. In some instances, model determination was difficult. For purposes of verification and ease in Quality Control/Quality Assurance activities, recording the vehicle color and any other obvious distinguishing features along with the make (model if readily identified) is required at a minimum.

The automobile dismantling/recycling facilities, because of the relatively low volume of end-of-life vehicles handled, have the ability to remove mercury convenience light switches and record data during the disassembly process normally undertaken by the facility. However, scrap processing/auto wrecking facilities which tend to handle much higher volumes of end-of-life vehicles find it more difficult to remove the mercury switches and record the data, as the processing operation needs to be adapted to accommodate inspection and removal.

The key components to implementation of a mercury convenience lighting switch removal program are:

1. Personnel Training to assure consistent, reliable switch removal.
2. Recordkeeping to document switch removal.
3. Financial incentive to assure consistent, reliable, ongoing switch removal.

6.0 Estimated Cost of Switch Removal

On the basis of the New Jersey Pilot Project findings, as well as those of the US EPA and others, it is clear that it takes less than 1 minute to remove a mercury convenience lighting switch unit from an end-of-life vehicle. The pilot project found that once through the 'learning curve' actual removal time is about 0.5 minute per switch.

However, in order to locate and remove all the mercury convenience lighting switches, it is necessary to inspect all vehicles, with the exception of Toyotas and Hondas, and remove all switches located. The time involved in inspecting a vehicle and locating switches or determining no switches are present takes approximately 3 minutes per vehicle. This examination could be performed in conjunction with other inspections performed by auto dismantlers and auto wreckers. The time varies depending on the condition of the vehicle. In most yards, approximately 50 percent of vehicles are damaged in some way that may have an adverse impact on inspection time. Preparing written documentation takes 1 minute per vehicle, whether or not switches are located. Therefore, approximately 4 minutes per vehicle is required, whether or not switches are located.

The New Jersey Pilot Project found an average of 0.8 switches per vehicle, other similar studies have found an average of 0.5 to 1 switch per vehicle.[8]

On the basis of no more than 1 switch per vehicle, total time required to inspect, locate, remove and document a mercury convenience light switch is less than 5 minutes per vehicle. If the cost of labor, including benefits and overhead is in the range of $25.00 to $40.00 per hour, the cost to locate, remove and document a switch is $2.00 to $3.00. This does not include handling and transportation expenses for the proper disposal of the mercury switches.

It should be noted that automotive repair industry estimating guides[9] report that the time for removal and replacement of hood and trunk convenience lighting switches ranges from 0.2 to 0.4 hours per switch, with the majority being 0.2 to 0.3 hours per switch. Therefore, removal only can be estimated to be 0.1 to 0.15 hours (6 to 9 minutes) per switch. The pilot study demonstrated that actual time required is less than these industry estimates.

The cost of processing and recycling a 5-gallon pail of mercury switch 'bullets' or switch assemblies is $150.00 plus shipping and handling as a Universal Waste.[10] Therefore, it would be advantageous from a cost standpoint to remove as many mercury switch 'bullets' as possible. The cost per switch for transportation, handling, processing and recycling of the switch assemblies is on the order of $1.00 per switch. Alternatively, if 'bullets' only are to be handled, cost per switch would be on the order of 5 cents, not including the cost of removing the bullet from the switch unit. Removal of the mercury-containing bullet is estimated to require approximately 0.75 minute[11] and therefore cost approximately 50 cents each. The total cost for mercury switch removal, handling, transportation, proper disposal and recordkeeping is conservatively estimated to be $3.00 per switch.

Removal of 4-wheel drive ABS switches is more complicated and time consuming. The easiest to locate and remove is the Chrysler/Jeep Grand Cherokee switch located beneath the rear seat. This requires removal via a wrench to unbolt the unit. Cost of removal of these units is estimated to be at least $5.00 per unit, allowing 7 to 8 minutes to locate, remove the rear seat, unbolt the unit, remove and document. Further, not all Grand Cherokee models were found to have the units, therefore in some cases, upon removal of the rear seat no switch will be found. Other 4-wheel drive ABS units require the vehicles to be raised on a lift and time requirements are 10 to 15 minutes per switch. Also, it is not possible to remove the mercury bullets from these units as they are encased in a plastic resin material (see Figure 3), hence shipping and handling costs will be significantly higher than for convenience lighting switches.

The US EPA[12] determined it was not cost effective to go beyond the hood and trunk convenience light switches. However, it appears that the Chrysler/Jeep Grand Cherokee ABS switches may be cost effective to remove. On a mercury weight basis, they are less costly to remove than hood and trunk convenience light switches. Each ABS sensor contains approximately 3 times as much mercury as the typical convenience light switch.

7.0 Recommendations for Implementation of a Regional Switch Removal Program

For a successful mercury switch removal program to be implemented to minimize mercury emissions in New Jersey, it should be a regional program. Ideally, New Jersey, New York, Pennsylvania, Connecticut and Delaware should participate in such a program.

Shredded scrap melted by the steel mills and foundries in New Jersey is procured from sources within these states. Even if the steel mills and foundries in New Jersey limited their purchases to New Jersey shredders, the New Jersey shredding facilities procure end-of-life vehicles from out-of-state sources, as discussed previously.

Mandatory mercury convenience light switch removal legislation or regulations in New Jersey alone will not assure that switches are removed prior to shredding from out-of-state sources. Since most end-of-life vehicles are crushed in preparation for shipping to the shredder, it is impossible to inspect such vehicles upon receipt at the shredding facility. Further, inspection of any vehicles at a shredding facility prior to shredding is very difficult without significantly disrupting operations, since shredders are high volume facilities, typically handling 40 to 100 vehicles per hour. Shredding facilities are generally high volume, low margin operations.[13]

If in-state scrap vehicle suppliers remove all mercury convenience light switches, but not out-of-state suppliers, shredders would have to segregate the incoming raw materials, as well as the shredded steel scrap product. New Jersey shredding facilities have limited storage space. This would add cost to the shredded steel product. A way to avoid such segregation would be to sell shredded steel product to out-of-state or international markets only. It should be noted that historically the bulk of New Jersey produced shredded scrap is sold in the export market. However, during the period 1998 through 2001, most scrap was sold domestically.

Pending Federal and state regulations[14,15] which mandate the use of mercury switch-free scrap by steel mills and foundries place the burden of monitoring mercury convenience lighting switch removal on the shredded scrap consumer. The consumer has no control over day to day operations of the facilities that need to remove switches. Therefore, one alternative which may be considered by some scrap consumers is

eliminating or significantly reducing the procurement and use of shredded scrap. To comply with pending rules, scrap suppliers must remove mercury convenience light switches and be subject to inspections.

A financial incentive is desirable in conjunction with regulations to maintain the flow of end-of-life vehicles to the shredders and low mercury content shredded scrap to the steel mills and foundries in New Jersey. The cost of such a program should be borne primarily by the automobile manufacturers responsible for the use of the mercury switches in their product. Steel mills and foundries desiring to utilize the shredded steel product as a raw material have no desire or use for any mercury that accompanies the scrap and are willing to assist in implementing effective removal programs. Additional end-of-pipe controls have not been demonstrated and cost effectiveness remains uncertain. Cooperative mercury switch removal efforts by all parties are appropriate. Such a cooperative effort in New Jersey could serve as a model for the region, or nationally.

As discussed previously, the total cost of location, removal, documentation, handling, transportation and proper disposal of mercury convenience lighting switches is approximately $3.00 each. A bounty of this amount in conjunction with regulations requiring removal of switches prior to the crushing or shredding of vehicles should result in removal of the bulk of mercury convenience lighting switches.

In New Jersey, mercury convenience lighting switch removal could also be mandated in the next revision to the Scrap Metal and Automotive Recycler General NJPDES Permit. Such permit (NJPDES General Permit No. NJ0107671) is due to expire November 30, 2004 and is scheduled to be revised and reissued by that date. More than 260 facilities in New Jersey are covered by this permit. The existing permit mandates removal of various automotive fluids prior to crushing or shredding since they have the potential to be released into the environment as a result of the shredding process. Metallic mercury, as a liquid has that same potential.

The implementation of any mercury switch removal program will require the full support of facility management for operator training and to assure ongoing consistency in inspection and removal of switches. Management motivation and attitude is key to any program.

As stated previously, it is desirable that any program be implemented on a regional basis due to the significant amount of interstate commerce involved in the handling and processing of end-of-life vehicles.

8.0 Projected Costs and Benefits

As discussed, approximately 500,000 vehicles are shredded annually in New Jersey. Based on the pilot study data and information, this means that the approximately 400,000 mercury convenience lighting switches are included with the vehicles shredded annually. As noted previously, the actual number of mercury switches could range from 250,000 to 500,000. Assuming the worst case of 1 switch per vehicle, and a cost of $3.00 per switch, the annual cost of a mercury switch removal program in New Jersey is $1.5 million.

When considering that the average mercury switch contains 1.2 grams of mercury as determined by the pilot study, that annual cost has the potential to remove 1300 pounds of mercury from the environment. Cost per pound of mercury removed would be $1154. This is comparable to the $1286 per pound cost estimated by the US EPA in the development of the proposed National Emissions Standard for Hazardous Air Pollutants for Iron and Steel Foundries.

9.0 References

[1] Ecology Center, Great Lakes United, University of Tennessee Center for Clean Products and Clean Technologies, "Toxics in Vehicles: Mercury," January 2001.

[2] Ibid

[3] Nachtman, J. and Hill, D., "Mercury in Automotive Systems – A White Paper," International Congress & Exposition, Paper #960409, SAE, Detroit, MI, February 1996.

[4] A Gross Ton, also known as Long Ton, is 2240 pounds. Common unit of measurement utilized in the steel and steel scrap industry.

[5] Compliance Emission Test Report, Gerdau-Ameristeel Sayreville, Melt Shop Baghouse Stack, February 2004.

[6] Gerdau-Ameristeel presentation at Mercury Switch Work Group Meeting, NJ DEP, December 18, 2003.

[7] Personal Communication, Fred Cornell, HNSE, February 2004.

[8] "Michigan Mercury Switch Study," December 19, 2002.

[9] Motor Information Systems, Crash Estimating Guides, Hearst Business Publishing, Inc., Troy, Michigan.

[10] Cost information provided by Comus International, Clifton, NJ and AERC Recycling Solutions, Allentown, PA.

[11] "Michigan Mercury Switch Study," December 19, 2002, p. 5.

[12] National Emissions Standards for Hazardous Air Pollutants for Iron and Steel Foundries, Proposed Final Rule, Summary of Environmental, Energy and Economic Impacts.

[13] "Management of End-of-Life Vehicles in the U.S.," March 2001, Center for Sustainable Systems, University of Michigan, Report No. CSS01-01.

[14] 40 CFR Part 63, Proposed Subpart EEEE, National Emission Standards for Hazardous Air Pollutants from Iron & Steel Foundries, September 2003.

[15] Proposed Regulations for the Control and Prohibition of Mercury Emissions, NJ DEP, Division of Air Quality, Permitting Element, DEP Docket No. 30-03-12/340.